

# BIOLOGY

## Interdepartmental Undergraduate Program

Iowa State University is a major center for research and education in the biological sciences. With over 200 faculty in the life sciences, students have the opportunity to learn from some of the nation's leaders in biological research and teaching and to participate in innovative, meaningful research projects that explore frontiers of biology. Few other universities have such a wealth of faculty expertise available to undergraduate students, making Iowa State's Biology Program the logical choice for those who want to participate in a thriving academic community.

The faculties of the Department of Ecology, Evolution, and Organismal Biology and the Department of Genetics, Development, and Cell Biology jointly offer the undergraduate biology major. This high quality academic program has the flexibility to accommodate a range of career goals while taking advantage of the university's strengths in science and technology. A bachelor's degree in biology provides excellent preparation for graduate study in biological disciplines ranging from the molecular to the ecological levels, and for entrance into various professional schools, such as human medicine, physical therapy, or veterinary medicine. The major is well suited for those who plan to teach biology, who wish to enter government or industrial employment in health or environmental professions, or who prefer educational breadth as an end in itself. By working with our professional advisors, it is possible to design a unique program of study that will meet student needs and objectives.

Students with special interests and aptitudes should consider combining biology with a minor or a second major in another subject, such as chemistry, environmental studies, journalism, mathematics, music, statistics, or many other subjects offered by the university.

### Customizing a degree

Biology encompasses an amazing diversity of disciplines and scales of study ranging from molecules to the biosphere. The Biology major offers a rich variety of coursework addressing most of the areas of biology. The major's curriculum requirements offer tremendous flexibility in creating an individualized program of study to facilitate achievement of a student's career goals, while simultaneously assuring some exposure to all areas of biology and providing complementary knowledge from supporting courses in chemistry, physics, and math/statistics.

While flexibility is the hallmark of the Biology major, the breadth of the field can also be challenging. Thus, in an effort to provide more guidance to students who desire such, the major also provides six advising tracks, or areas of specialization, for students who wish to focus on subfields of

biology or who have specific career goals in mind. Course plans for each area of specialization are listed on the Biology web site. The areas are:

**Pre-medical and Human Health Professions**--This area emphasizes preparation for further study in medical school or allied human health professions such as dentistry, optometry, genetic counseling, physical therapy, occupational therapy, physician assistant, nursing, chiropractic, and others. It also will prepare students for a broad range of careers in the biological sciences. Students are urged to determine the specific entrance requirements for the professional schools where they might study and to plan a program of study accordingly, in addition to following the basic plan.

**Pre-veterinary**--An eventual degree in Veterinary Medicine can lead to a wide variety of careers, including private clinical practice in small animal medicine or agricultural animal production. But, pre-veterinary students can also prepare themselves for careers in animal research, public health, laboratory animal medicine, food safety, regulatory medicine, and education. Specific requirements for entrance to the Iowa State Veterinary College or other schools should be consulted as programs of study are planned, in addition to following the basic plan.

**Molecular and Cellular Biology**--Students specializing in this field will explore the structure, function, and interactions of the molecules and sub-cellular features that make up living cells. This area is particularly designed for those who plan to pursue a career in research in molecular or cell biology or in related areas such as biochemistry, genetics, microbiology, developmental biology, human medicine, or veterinary medicine. Many students in this area will choose to go on to graduate school.

**Ecology and Conservation Biology**--Ecologists examine the interactions and relationships that living organisms have with each other and their environment. Conservation biologists study the nature and status of Earth's biodiversity with the aim of protecting species, their habitats, and ecosystems from excessive rates of extinction and loss. Students who choose this specialization may go on to work for a non-profit environmental group; an environmental consulting firm; a local, state, or federal agency; or other related organizations. Many students in this area will choose to go on to graduate school.

**Evolution and Biodiversity**--This area provides students with a sound understanding of evolutionary principles and the biological patterns that result from evolutionary change. Students have the opportunity to explore, in depth, the biodiversity found within a wide range of groups of organisms. Students who choose this specialization may go on to work for a non-profit environmental group; an environmental consulting firm; a local, state, or federal agency; or other related organizations. Many students in this area will choose to go on to graduate school.

Teacher licensure—Biology majors seeking recommendation for licensure to teach biology in secondary schools must meet requirements of the Teacher Education Program as well as those of the Biology Program. In addition, they must apply formally for admission to the teacher education program. See the section on Teacher Education for a list of licensure areas, degree requirements, and other information about this program.

## Other opportunities

Undergraduate research—Students who have interests in biological research are encouraged to become involved in the research projects of faculty members on campus. Those doing so may receive credit for the experience in BIOL 499 Undergraduate Research Experience.

Making the effort to find a suitable research mentor and engaging in research work can be one of the most valuable experiences of an undergraduate education. Internship experiences are often available at other universities, zoos, museums, governmental and non-governmental entities focused on environmental issues, and industrial or government laboratories. Students participating in such projects may receive internship credit in BIOL 494 Biology Internship.

Field trip courses – The Biology Program offers two field trip courses: BIOL 393 (North American Field Trips in Biology) and BIOL 394 (International Field Trips in Biology). In recent years field trip opportunities to Honduras and Spain have been available. These courses involve a pre-trip seminar followed by one-week to one-month long field trip at a time when academic year classes are not in session. The classes are low enrollment and allow extensive interaction between instructors and students in locations of biological interest.

International experience—Because major discoveries in science often result from global efforts, biology majors are encouraged to include an international or study abroad component in their degree programs. This can be done by participating in international field trips originating from the ISU campus in BIOL 394 International Field Trips in Biology. In addition, many students choose to study abroad, attending a university in another country for up to a year as an exchange student. Minors in a foreign language can also add an international emphasis to a degree in biology.

## Courses offered at other locations

In addition to biological science courses taught on campus, students may take courses at various remote locations and arrange to have the credits count toward the advanced courses required in the biology major.

Attending a summer field station adds an important component to an undergraduate program of study.

Gulf Coast Research Laboratory—The Gulf Coast Research Laboratory is affiliated with the University of Southern Mississippi. Iowa State students may register for marine biology courses and transfer credit to their degree programs under the number BIOL 480 Studies in Marine Biology.

Written permission of the Biology Program Director is required for this arrangement.

Summer Biological Field Stations—Courses taken at summer field stations may be transferred to Iowa State University as credit in BIOL 481 Summer Field Studies. Such stations are found throughout the country and often offer courses that emphasize the adaptation of plants and animals to unique environments. See [www.biology.iastate.edu](http://www.biology.iastate.edu) (<http://www.biology.iastate.edu/>) for links to Iowa Lakeside Laboratory and other field stations in different biomes, e.g., marine/coastal, Great Lakes, taiga, deciduous forests, deserts, Rocky Mts., etc.

Organization for Tropical Studies—Iowa State students may register for courses in tropical biology taught in Costa Rica by the Organization for Tropical Studies. Credit is transferred to Iowa State as BIOL 482 Tropical Biology. For further information, contact the Biology Student Services Office in 103 Bessey Hall.

## Student Learning Outcomes

Upon graduation, students should be able to:

- Explain and apply the core biological concepts of:
  - Evolution
  - Structure and function
  - Information flow, exchange, and storage
  - Pathways and transformations of energy and matter
  - How systems are interconnected and interact
- Apply the process of science
- Use quantitative reasoning
- Use modeling and simulation
- Utilize, communicate with, and collaborate with other disciplines
- Understand the relationship between science and society

## Undergraduate Study

Biology majors start their studies in the biological sciences by taking a two-semester long Principles of Biology course sequence:

BIOL 211	Principles of Biology I	3
BIOL 211L	Principles of Biology Laboratory I	1
BIOL 212	Principles of Biology II	3
BIOL 212L	Principles of Biology Laboratory II	1

During the first year, students also take BIOL 110 Introduction to Biology and BIOL 111 Opportunities in Biology, which are half-semester courses designed to introduce the student to the discipline of biology and opportunities for careers in biology. Students transferring into the Biology major take BIOL 112 in place of BIOL 110 and BIOL 111.

Students then explore, in any order depending on their interests, four upper-level core courses including: concepts of ecology in BIOL 312; the principles of genetics in BIOL 313 and BIOL 313L; cell and molecular biology in BIOL 314; and evolutionary biology in BIOL 315. Biology majors must take an additional 21 credits of advanced biological science courses at the 300 level, or above, from an approved list of courses. Many of these courses have as prerequisites BIOL 211/L and BIOL212/L, so students do not need to complete the four upper-level core courses before taking advanced courses. Of these advanced courses, at least 9 credits must be taken as BIOL courses, and a minimum of two laboratory or field courses must also be included from an approved list.

Biology majors should carefully consider their selection of upper-level courses to allow them to emphasize one, or more, of the sub-disciplines of Biology relevant to their post-baccalaureate objectives. Most biology courses numbered 300 or above can be used to satisfy the additional credit requirement. Some courses taught in other departments can also be applied to the biology major. Advanced students should consider including 500 level courses in their programs. The Biology Program's web site has a complete listing of acceptable upper-level life science courses.

Biology majors must demonstrate competency in their understanding of the biological sciences. A 2.0 cumulative average is required in biology and advanced biology coursework. In order to graduate, a student must have a cumulative average in the major of at least 2.00.

## General requirements

Students may earn the B.S. degree in Biology from either the College of Liberal Arts and Sciences or from the College of Agriculture and Life Sciences. Students in the College of Liberal Arts and Sciences must fulfill the College of Liberal Arts and Sciences (<http://catalog.iastate.edu/previouscatalogs/2023-2024/collegeofliberalartsandsciences/#lascollegerequirementstext>) and University-wide requirements (<http://catalog.iastate.edu/previouscatalogs/2023-2024/collegescurricula/>) for graduation in addition to those stated for the major. Students in the College of Agriculture and Life Sciences must meet University-wide requirements (<http://catalog.iastate.edu/previouscatalogs/2023-2024/collegescurricula/>) for graduation and requirements for that college. Contact the Student Services Office for details regarding differences in general education and course requirements that are specific to these colleges.

Supporting course requirements – Understanding biology requires a basic understanding of the physical sciences and mathematics. Consequently, a minimum number of credits in general chemistry, organic chemistry, biochemistry, and physics is required. See the Biology Program Web Site for specific supporting science requirements.

The Math requirement is competency based. After demonstrating competency in algebra and trigonometry, biology majors must take two

semesters of calculus; or two semesters of Statistics; or one semester of calculus and one semester of Statistics chosen from a list of approved courses available on the Biology Program Web Site and in the Biology Program Office.

Given the important role of communications in the modern sciences, biology majors must demonstrate communication competency by earning a minimum of C in ENGL 250 Written, Oral, Visual, and Electronic Composition or equivalent composition courses and in one advanced writing course numbered ENGL 302 through ENGL 316, or JL MC 347, or SP CM 212. (Students in the College of Agriculture and Life Sciences are required to earn a C or better in ENGL 150, as well.)

## Curriculum in Biology

Administered by the Departments of Ecology, Evolution, and Organismal Biology; and Genetics, Development and Cell Biology. Students should consult the Biology Student Services Office, 103 Bessey (or [biology@iastate.edu](mailto:biology@iastate.edu)) for the appropriate course selections for professional or graduate school preparation.

### Total Degree Requirement: 120 cr.

Only 65 cr. from a two-year institution may apply which may include up to 16 technical cr.; 9 P-NP cr. of free electives; 2.00 minimum GPA.

### Biology: 23.5 cr.

2.00 GPA average required.

BIOL 110	Biology Major Orientation	1
BIOL 111	Opportunities in Biology	0.5
BIOL 211	Principles of Biology I	3
BIOL 211L	Principles of Biology Laboratory I	1
BIOL 212	Principles of Biology II	3
BIOL 212L	Principles of Biology Laboratory II	1
BIOL 312	Ecology	4
BIOL 313	Principles of Genetics	3
BIOL 313L	Genetics Laboratory	1
BIOL 314	Principles of Molecular Cell Biology	3
BIOL 315	Biological Evolution	3
<b>Total Credits</b>		<b>23.5</b>

### Advanced Biology: 21 cr.

2.00 GPA average required. Must include two approved Advanced Biology labs. See the Biology Program website for list of approved Advanced Biology courses, or consult an advisor in the Biology Student Services office, 103 Bessey Hall.

Biology advanced courses (from approved list)	9
Additional approved biology advanced courses	12
<b>Total Credits</b>	<b>21</b>

### Mathematical Sciences 7 cr.

Students in College of Agriculture and Life Sciences must have a Math and Statistics.

MATH 160 or MATH 165 and STAT 101 or STAT 104	
Or	
MATH 165      Calculus I	8
& MATH 166      and Calculus II	
Or	
STAT 101 or STAT 104 and STAT 301	4-7

### Physical Sciences

General Chemistry: 5 cr. minimum

CHEM 163      College Chemistry	5
& 163L          and Laboratory in College Chemistry	

Or

CHEM 177      General Chemistry I	5
& 177L          and Laboratory in General Chemistry I	

CHEM 178      General Chemistry II	4
& 178L          and Laboratory in College Chemistry II	

Organic Chemistry: 4 cr. minimum

CHEM 231      Elementary Organic Chemistry	4
& 231L          and Laboratory in Elementary Organic Chemistry	

Or

CHEM 331      Organic Chemistry I	4
& 331L          and Laboratory in Organic Chemistry I	

Biochemistry: 3 cr.

BBMB 316      Principles of Biochemistry	3
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Or

BBMB 404      Biochemistry I	3
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Or

BBMB 420      Mammalian Biochemistry	3
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Physics: 5 cr. minimum

PHYS 115      Physics for the Life Sciences	5
& 115L          and Laboratory in Physics for the Life Sciences	

Or

PHYS 131      General Physics I	5
& 131L          and General Physics I Laboratory	

PHYS 132      General Physics II	5
& 132L          and General Physics II Laboratory	

### International Perspective: 3 cr.

### U.S. Diversity: 3 cr.

### Communication/Information Literacy

Students must earn a C or better in ENGL 250 and the advanced communication course. Additionally, students in the College of Agriculture and Life Sciences must earn a C or better in ENGL 150. Students should consult their advisor to discuss advanced communication course options other than SP CM 212.

ENGL 150	Critical Thinking and Communication	3
ENGL 250	Written, Oral, Visual, and Electronic Composition	3
LIB 160	Introduction to College Level Research	1
SP CM 212	Fundamentals of Public Speaking	3

**Total Credits** **10**

### Humanities and Social Sciences

Chosen from approved lists.

LAS - Biology

Note: Students must have completed 3 years of a single world language or take 4-8 credits of university level world language.

Humanities	12
Social Sciences	9
Career Preparation (LAS 203)	1

**Total Credits** **22**

### Humanities and Social Sciences

Chosen from approved lists.

CALS - Biology

Note: Students in CALS - Biology must take an approved speech course and an approved Math and Statistics course.

Humanities	3
Social Sciences	3
Ethics	3
<b>Total Credits</b>	<b>9</b>

### Biology, B.S. (College of Agriculture and Life Sciences)

The minimum number of credits required to graduate is 120. Students are required to take 21 credits in advanced biology of which 9 credits must be from the Biology Program (BIOL). At least two advanced courses must have a lab or field component.

## General Sample Plan

### Freshman

Fall	Credits	Spring	Credits	Summer	Credits
BIOL 110		1 BIOL 212		3 All Summers: Consider internship, study abroad, field stations, research, clinical observation	
BIOL 111	0.5	BIOL 212L		1	
BIOL 211	3	Chemistry*		4	
BIOL 211L	1	Social Science Choice		3	
CHEM 163 or 177*	4	Math/Stat Choice*		4	
CHEM 163L or 177L*	1				
ENGL 150 or 250	3				
LIB 160	1				
		<b>14.5</b>		<b>15</b>	<b>0</b>

### Sophomore

Fall	Credits	Spring	Credits
ENGL 250 (or Elective)		3 BIOL 313	3
BIOL 314		3 BIOL 313L	1
Chemistry or Elective*	3-4	Biochemistry*	3
Advanced Biology	3	Math/Stat Choice*	4
Humanities Choice	3	Elective Choice	3
		<b>15-16</b>	<b>14</b>

### Junior

Fall	Credits	Spring	Credits
BIOL 312	4	BIOL 315	3

Advanced Biology	3	Advanced Biology with Lab	4
PHYS 115 or 131*	4	PHYS 132 (or Elective)*	4
PHYS 115L or 131L*	1	PHYS 132L (or Elective)*	1
Ethics Choice	3	U.S. Diversity	3
		<b>15</b>	<b>15</b>

### Senior

Fall	Credits	Spring	Credits
Advanced Biology	4	Advanced Biology with Lab	4
International Perspectives	3	Advanced Biology	3
SP CM 212 or COMST 214	3	Minor or Electives	9
Minor or Electives	6		
		<b>16</b>	<b>16</b>

**Total Credits: 120.5-121.5**

\* Students should meet with an academic advisor to determine the proper plans for chemistry, math and physics before selecting those options above.

### Biology, B.S. (College of Agriculture and Life Sciences)

### Pre-Medical Sample Plan

Please note that professional school requirements vary by program.

**Freshman**

Fall	Credits	Spring	Credits	Summer	Credits
BIOL 110		1 BIOL 212		3 All Summers: Consider internship, study abroad, field stations, research, clinical observation	
BIOL 111		0.5 BIOL 212L		1	
BIOL 211		3 CHEM 178		3	
BIOL 211L		1 CHEM 178L		1	
CHEM 177		4 MATH 160 or 165		4	
CHEM 177L		1 PSYCH 101		3	
ENGL 150 or 250		3			
LIB 160		1			
		<b>14.5</b>	<b>15</b>	<b>0</b>	

**Sophomore**

Fall	Credits	Spring	Credits
BIOL 314		3 Advanced Biology Choice	3
CHEM 331		3 BIOL 313	3
CHEM 331L		1 BIOL 313L	1
ENGL 250 (or Elective)		3 CHEM 332	3
STAT 104 or 101		3-4 CHEM 332L	1
FS HN 367		1 Ethics Choice Elective	3  2
		<b>14-15</b>	<b>16</b>

**Junior**

Fall	Credits	Spring	Credits
BBMB 316 or 404		3 BBMB 405 (Or Advanced Biology Choice)	3
BIOL 350		4 BIOL 335	3
SOC 134		3 BIOL 335L	1
PHYS 131		4 US Diversity	3
PHYS 131L		1 PHYS 132 PHYS 132L	4 1
		Take MCAT in May or June Submit application in June or July	
		<b>15</b>	<b>15</b>

**Senior**

Fall	Credits	Spring	Credits
Advanced Biology Choice		3 Advanced Biology Choice	3
SP CM 212 or COMST 214		3 BIOL 315	3
BIOL 312 (with lab)		4 Humanities Choice	3
International Perspectives Elective		3 Elective	6  3
		<b>16</b>	<b>15</b>

**Total Credits: 120.5-121.5****Biology, B.S. (College of Agriculture and Life Sciences)****Pre-Physician Assistant Sample Plan**

Please note that professional school requirements vary by program.

**Freshman**

Fall	Credits	Spring	Credits	Summer	Credits
BIOL 110		1 BIOL 212		3 All Summers: Consider internship, study abroad, field stations, research, clinical observation	
BIOL 111		0.5 BIOL 212L		1	
BIOL 211		3 CHEM 178		3	
BIOL 211L		1 CHEM 178L		1	
CHEM 177		4 MATH 160 or 165		4	
CHEM 177L		1 PSYCH 101		3	
ENGL 150		3			
LIB 160		1			
		<b>14.5</b>		<b>15</b>	<b>0</b>

**Sophomore**

Fall	Credits	Spring	Credits
BIOL 314		3 Advanced Biology Choice	3
CHEM 231		3 BIOL 313	3
CHEM 231L		1 BIOL 313L	1
Or CHEM 331 & CHEM 331L		Elective	3
ENGL 250 (or Elective)		3 International Perspectives + Humanities Choice	3
STAT 104 or 101		3-4 PSYCH 230	3
FS HN 367		1	
		<b>14-15</b>	<b>16</b>

**Junior**

Fall	Credits	Spring	Credits
BBMB 316		3 Advanced Biology	3
BIOL 312		4 BIOL 335	3
BIOL 350		4 BIOL 335L	1
Elective		2 US Diversity + Ethics	3
PSYCH 460		3 PHYS 115/ L or PHYS 131/L	5
		<b>16</b>	<b>15</b>

**Senior**

Fall	Credits	Spring	Credits
Advanced Biology Choice Written Communication/ Speech		3 Advanced Biology Choice 3 Elective	3
BIOL 315		3 Elective	3
Elective		3 Elective	3
Elective		3 Elective	3
		<b>15</b>	<b>15</b>

**Total Credits: 120.5-121.5**

**Biology, B.S. (College of Agriculture and Life Sciences)**

**Pre-Physical Therapy Sample Plan**

Please note that professional school requirements vary by program.

**Freshman**

Fall	Credits	Spring	Credits	Summer	Credits
BIOL 110		1 BIOL 212		3 All Summers: Consider internship, study abroad, field stations, research, clinical observation	
BIOL 111		0.5 BIOL 212L		1	

BIOL 211	3 CHEM 178	3	
BIOL 211L	1 CHEM 178L	1	
CHEM 177	4 MATH 160 or 165	4	
CHEM 177L	1 PSYCH 101	3	
ENGL 150 or 250	3		
LIB 160	1		
	<b>14.5</b>	<b>15</b>	<b>0</b>

**Sophomore**

Fall	Credits	Spring	Credits
BIOL 314		3 Advanced Biology	3
CHEM 231		3 BIOL 313	3
CHEM 231L		1 BIOL 313L	1
ENGL 250 (or Elective)		3 Elective	3
STAT 101 or 104		3-4 International Perspectives +Humanities Choice	3
FS HN 367		1 Elective (Psych course recommended)	3
	<b>14-15</b>	<b>16</b>	

**Junior**

Fall	Credits	Spring	Credits
BBMB 316		3 Advanced Biology	3
US Diversity + Ethics		3 BIOL 335	3
BIOL 350		4 BIOL 335L	1
PHYS 131		4 Elective	3
PHYS 131L		1 PHYS 132 PHYS 132L	4 1
	<b>15</b>	<b>15</b>	

**Senior**

Fall	Credits	Spring	Credits
Advanced Biology Choice		3 Advanced Biology Choice	3

SP CM 212 or COMST 214	3 Elective	3
BIOL 312 (with lab)	4 BIOL 315	3
Elective	3 Elective	3
Elective	3 Elective	3
	<b>16</b>	<b>15</b>

**Total Credits: 120.5-121.5****Minor**

A minor in Biology is offered by the Biology Program. The minor requires 15 credits in Biology and includes the completion of the specific courses listed below and 7 credits in biology courses numbered 300 or above. Nine (9) credits of the required courses must apply only to the minor. For more information, see the Biology Program web site or contact the Student Services Office in 103 Bessey Hall.

BIOL 211	Principles of Biology I	3
BIOL 211L	Principles of Biology Laboratory I	1
BIOL 212	Principles of Biology II	3
BIOL 212L	Principles of Biology Laboratory II	1

**Total Credits 8****Graduate Programs**

Biology is an undergraduate major only. Persons interested in graduate study in the biological sciences should apply directly to one of the life science graduate programs at Iowa State University.

**Programs**

- Bioinformatics and Computational Biology
- Ecology and Evolutionary Biology
- Genetics
- Molecular Cellular and Developmental Biology
- Neuroscience
- Plant Biology
- Toxicology
- Immunobiology
- Environmental Science

**Interdisciplinary Graduate Studies**

A non-thesis master's degree in Interdisciplinary Graduate Studies (biological sciences) has been established particularly for those who wish to have a more diversified program of advanced study than that generally permitted by specific departments and programs.